# Title of Slide Presentation

## Tools and Technology for Accessible Trails

Peter Axelson
Jeremy Vlcan

Beneficial Designs, Inc.
Minden, Nevada

**Arroya Sit Ski**

**Hand Bike**

**Mono Ski**

**Dynamic Seating Spring Assist**

**Cross Country Ski**

# Title of Slide Presentation

**Pax Back**


Available from
**BES Rehab Ltd**

**Aircraft Aisle Chair**

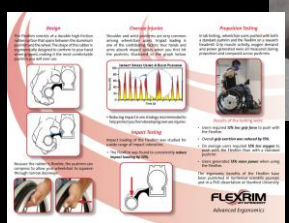
**Dynamic Seating**

**HipGrip**

**The HipGrip is a postural seating device designed to help control pelvic position and provide stability while in a wheelchair while allowing range of motion and movement in anterior and posterior pelvic tilt.**

Available from
**Bodypoint**

**FlexRim**




**GripRim**

# Title of Slide Presentation

**Adaptive Canoe Seating**

Available from
**Chosen Valley Canoe Accessories**

## What makes a great trail?

- Providing trail access information
- Preventing access barriers
- Improving trail surfaces
- Protecting the environment

- "Moderate" or "Easy" mean different things
- People have different abilities (young children, older adults, people with disabilities, unfit and inexperienced individuals)
- Assessment must provide objective information

## Assessment and Compliance

- Inventory existing facilities and infrastructure
- Determine compliance with existing ADAAG and Developed Outdoor Recreation facilities
- Create transition plan with goals and objectives for accomplishing access

**Title of Slide Presentation**


## Key UTAP Information

Length 

Grade 

Width 

Surface 

Cross slope 

Features & Facilities 

## UTAP Assessment Team

## UTAP – Implementation Status

- Over 1000 people trained to lead UTAP assessments
- Over 55 trainers to teach UTAP workshops
- State and agency-wide implementation is growing (AZ, MN, IN, NY, CA, FL)
- UTAP assessments available from consultants

## Development of a Complete Outdoor Recreation Assessment Process

- Develop and validate a repeatable assessment process for all Outdoor Recreation Elements
- Create instructions and data collection forms to determine compliance
- Set up electronic data collection and data base for management of information

## Title of Slide Presentation

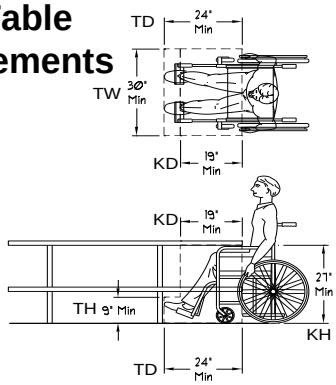
### DORAP Deliverables

- Data collection forms with instructions
- Software to record and export data
- Tool kit for performing all measurements
- One day training course on DORAP
- Web based DORAP training course
- Combine with UTAP for comprehensive training

### DORAP applies too

- Urban or rural trails of any type
- City, county and state parks
- Picnic and camping facilities
- Visitor centers and rest areas
- Any public area that has any Outdoor Recreation Elements

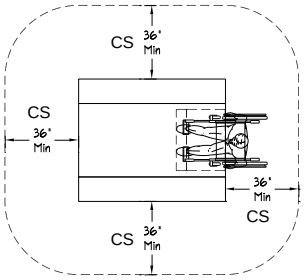
## Picnic Table Measurements




**Measurement Comparisons**

| Name | Premmiter Feet | Spaces Req'd | Total Width Inches | Knee Depth Inches | Knee Height Inches | Toe Depth Inches | Toe Height Inches |
|---|---|---|---|---|---|---|---|
| Minimum | | 1 | 30 | 19 | 27 | 24 | 9 |
| P.K. | ~ | 1 | 37 | 8 | 27.5 | 8 | 27.5 |
| K.N. | ~ | 1 | 28 | 9 | 27 | 9 | 27 |
| J.V. | 16.8 | 1 | 36 | 8 | 28 | 8 | 28 |
| B.B. | 16.4 | 1 | 37 | 7.5 | 27 | 7.5 | 27 |
| J.S | 14 | 1 | 37 | 8 | 27 | 8 | 27 |
| S.P. | 16.6 | 1 | 37 | 8 | 27 | 8 | 27 |

## Picnic Table Clearance




### Measurement of Surface Firmness and Stability

- Rotational penetrometer developed to objectively measure surfaces
- Portable device that can be used in the field
- Allows measurement of carpets, playgrounds and trail surfaces

# Title of Slide Presentation

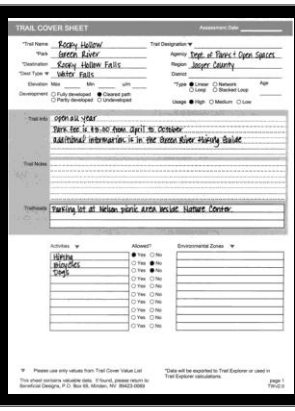
## Rotational Penetrometer

Objective surface measurement device

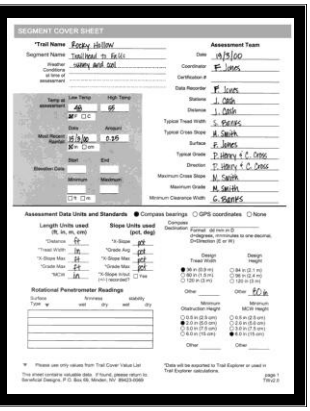
Draft Standard for measure of firmness and stability under development

Available from Beneficial Designs

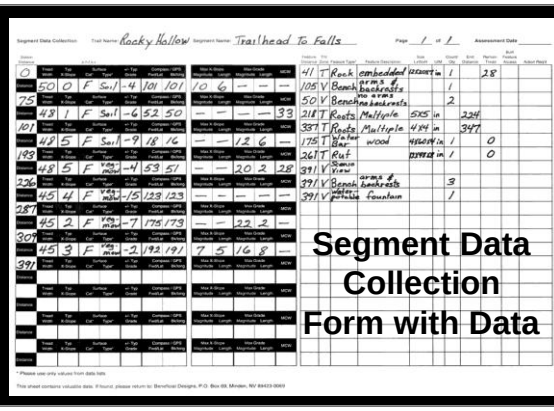
## Trail Cover Sheet with Data




## Segment Cover Sheet with Data

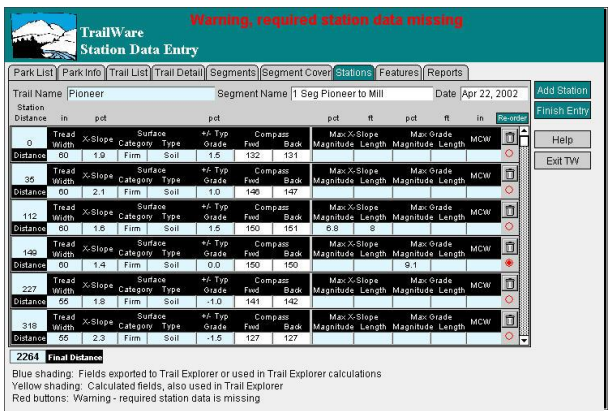



## Segment Data Collection Form with Data




## Trailware

- Store and manage trail data
- Split, copy, reverse and combine trail segments into trails for processing
- Process data to generate grade, cross-slope, tread width and surface reports
- Create Summary trail access information



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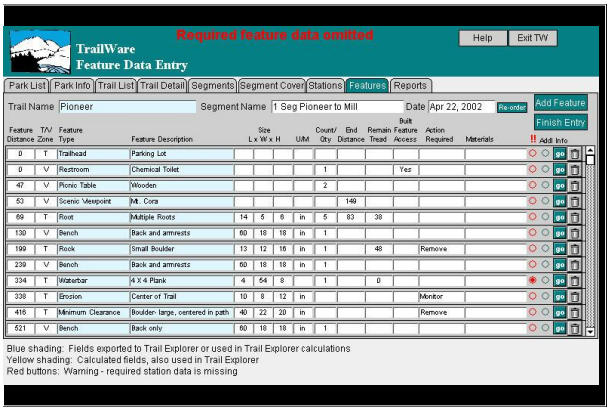
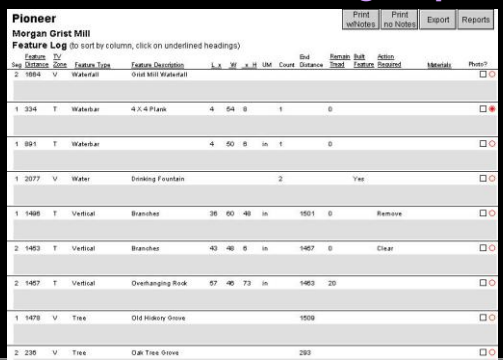


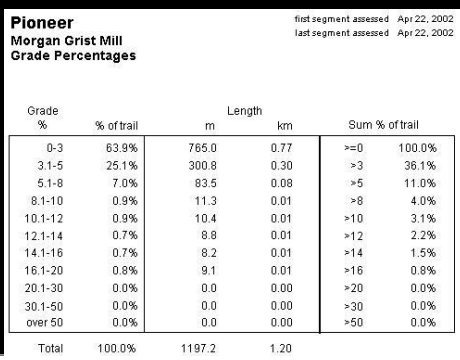

## TrailWare Reports

- English or Metric units
- Data summaries:
  - Grade, Cross Slope and Width
  - Surface Category and Type
  - Tread and Vertical Obstructions
- Trail Access Information

## Station or Feature Log Report




## Summary Tables for Typicals

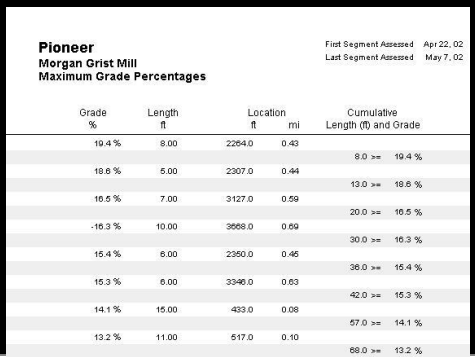


**Pioneer**
**Morgan Grist Mill**
**Grade Percentages**

first segment assessed Apr 22, 2002
last segment assessed Apr 22, 2002

| Grade % | % of trail | Length m | Length km | Sum % | % of trail |
|---|---|---|---|---|---|
| 0-3 | 63.9% | 765.0 | 0.77 | >=0 | 100.0% |
| 3.1-5 | 25.1% | 300.8 | 0.30 | >3 | 36.1% |
| 5.1-8 | 7.0% | 83.5 | 0.08 | >5 | 11.0% |
| 8.1-10 | 0.9% | 11.3 | 0.01 | >8 | 4.0% |
| 10.1-12 | 0.9% | 10.4 | 0.01 | >10 | 3.1% |
| 12.1-14 | 0.7% | 8.8 | 0.01 | >12 | 2.2% |
| 14.1-16 | 0.7% | 8.2 | 0.01 | >14 | 1.5% |
| 16.1-20 | 0.8% | 9.1 | 0.01 | >16 | 0.8% |
| 20.1-30 | 0.0% | 0.0 | 0.00 | >20 | 0.0% |
| 30.1-50 | 0.0% | 0.0 | 0.00 | >30 | 0.0% |
| over 50 | 0.0% | 0.0 | 0.00 | >50 | 0.0% |
| Total | 100.0% | 1197.2 | 1.20 | | |

## Extreme Summary Tables



**Pioneer**
**Morgan Grist Mill**
**Maximum Grade Percentages**

First Segment Assessed Apr 22, 02
Last Segment Assessed May 7, 02

| Grade % | Length ft | Location ft | Location mi | Cumulative Length (ft) and Grade |
|---|---|---|---|---|
| 19.4 % | 8.00 | 2264.0 | 0.43 | |
| | | | | 8.0 >= 19.4 % |
| 18.6 % | 5.00 | 2307.0 | 0.44 | |
| | | | | 13.0 >= 18.6 % |
| 16.5 % | 7.00 | 3127.0 | 0.59 | |
| | | | | 20.0 >= 16.5 % |
| -16.3 % | 10.00 | 3668.0 | 0.69 | |
| | | | | 30.0 >= 16.3 % |
| 15.4 % | 6.00 | 2350.0 | 0.45 | |
| | | | | 36.0 >= 15.4 % |
| 15.3 % | 6.00 | 3346.0 | 0.63 | |
| | | | | 42.0 >= 15.3 % |
| 14.1 % | 15.00 | 433.0 | 0.08 | |
| | | | | 57.0 >= 14.1 % |
| 13.2 % | 11.00 | 517.0 | 0.10 | |
| | | | | 68.0 >= 13.2 % |

## TrailWare Calculations

- Typical and extreme values for
  - Grade, Cross Slope and Width
- Surface Category and Type
- Tread and Vertical Obstructions

## Title of Slide Presentation

### Development Support

- Universal Trail Assessment Process
- Rotational Penetrometer and
- Trailware, trail data processing software
- All supported with funding from the NIH NICHD National Center for Medical Rehabilitation Research SBIR Program

### Wheeled Instrumentation Sensor Package - WISP

- Stroller – 3 wheeled jogging stroller with 22 inch wheelbase
- Rolawheel – measures 13 inch width and 18 inch length
- ATV – collects grades and x-slopes based on the vehicle wheelbase
- OHV – same as ATV





HETAP-
Rollawheel

**Title of Slide Presentation**


## WISP Features

- One person operation to record grade and cross slope information
- Distance – forward/reverse
- Standard USB sensor box interface
- Laptop with Weather resistant touch screen recommended
- Extra battery suggested

## WISP Hardware

- High speed sampling and adjustable digital filtering of grade and cross slope
- Dual reed switches to sense forward and backward movement

## WISP Software Interface

- Designed for ETRACS compatibility
- Component Object Module (COM) interface to request distance, grade and cross slope
- Calibration routine provided
- Compatible with HETAP 2.0 software

## High Efficiency Trail Assessment Process - HETAP Software 2.3

- Software that guides the user to collect objective surface and feature trail data
- Sort data to create grade, cross slope, surface and tread width reports
- SQL data base for compatibility with larger data base systems
- Calculation of Trail Access Information

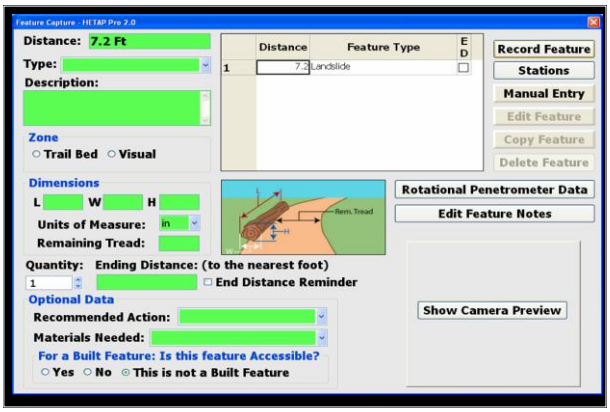
# Title of Slide Presentation

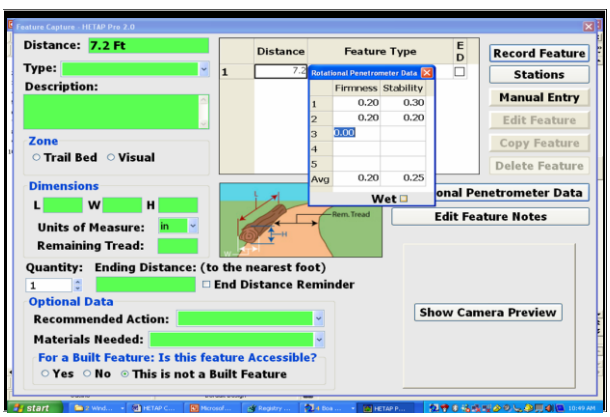
## HETAP 2.3 Station Data

- Automatic recording of grade, cross-slope and distance
- Automatic capture of GPS position
- Automatic image capture
- Programmable alarms for grade and cross-slopes


## HETAP 2.4 Feature Data

- Feature type drop down lists
- Provides for recording of rotational penetrometer firmness/stability
- Image capture of features

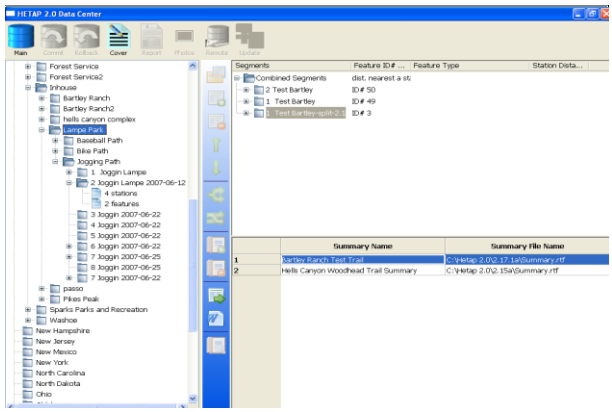


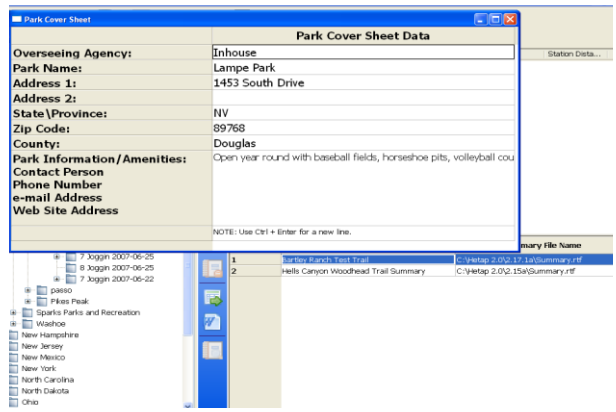



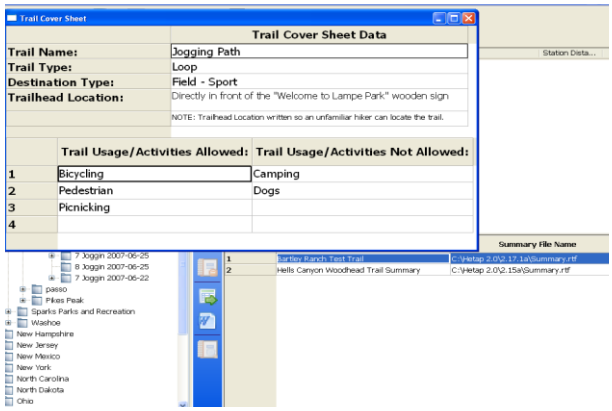

## HETAP 2.3 System Features

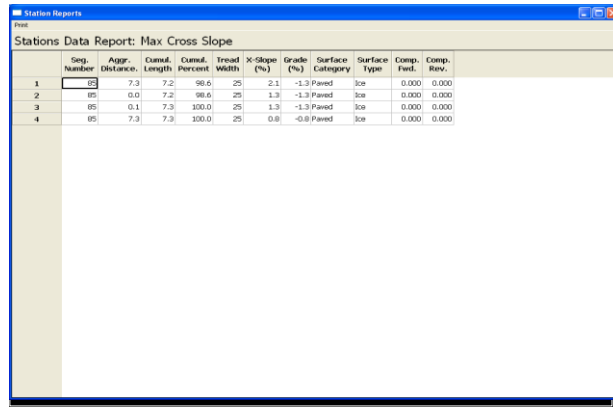
- Data center to generate reports with sorting
- Combine, reverse and split trail segments for data processing
- Create TAI summary reports

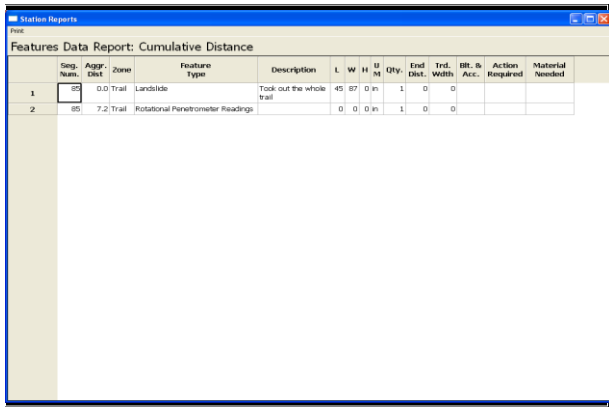
# Title of Slide Presentation




## Trail Information Formats

- Trail Access Information - TAI Information sheets
- TAI Laminated strip decals
- Full panel signage with TAI
- TAI on Web Site

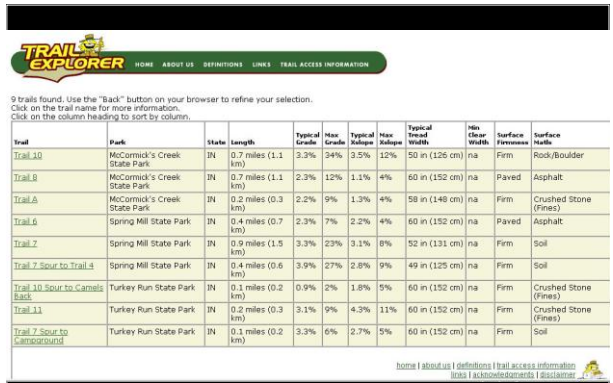
# Title of Slide Presentation

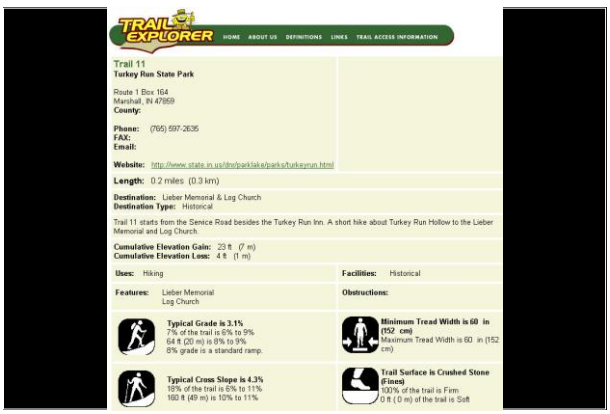
## Computer Kiosk or Internet Site



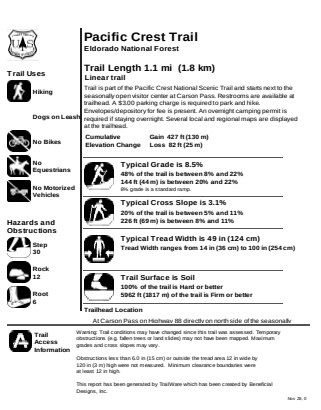
www.trailexplorer.org


www.trailexplorer.org




## TAI Information Sheet



## Title of Slide Presentation


## TAI Trail Signing Examples


TAI on Carsonite & Existing Signpost

TAI on Wooden Post

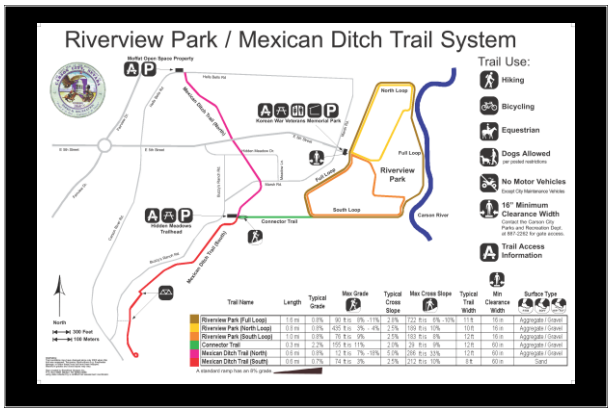
Narrow Trails

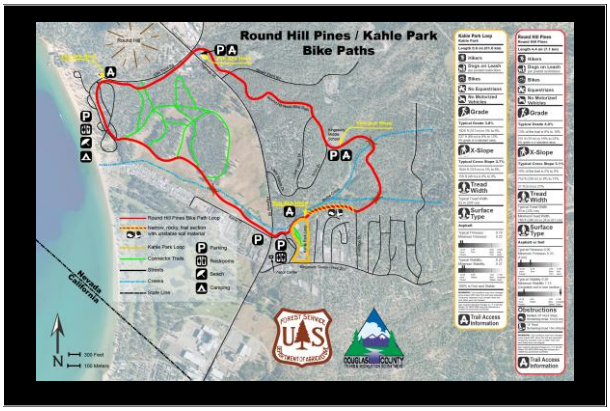
Color and Logos

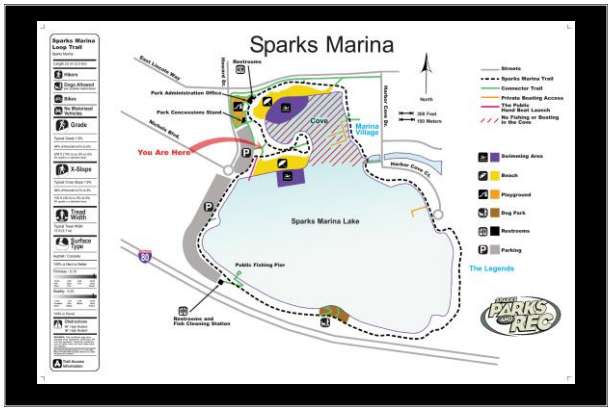
## Full Panel Signage Examples

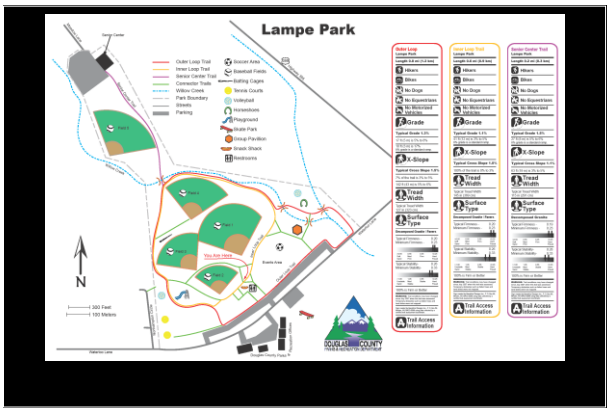
- Trail Access Information
- Top view map for location information
- Agency Logo
- Locator information

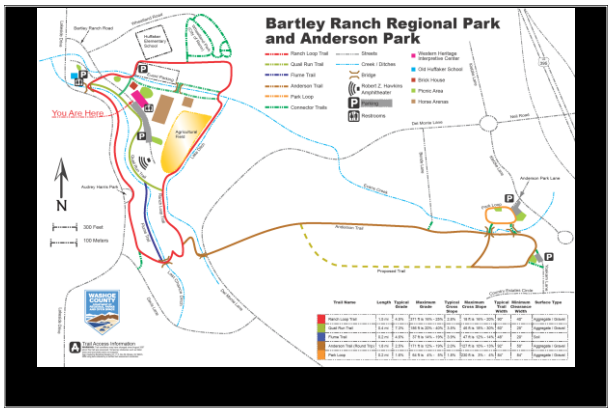
# Title of Slide Presentation

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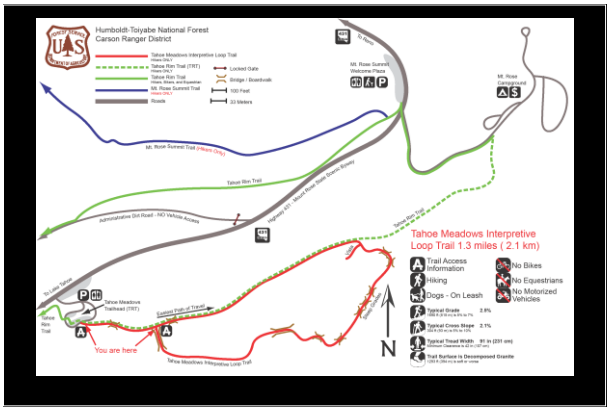




## Preventing Access Barriers

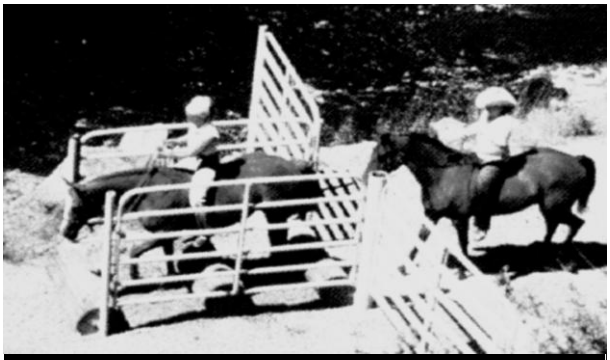
- Need to provide access to all allowed user groups
- Need to prevent those user groups not allowed



Deschutes Cattle Guard Barrier

**Title of Slide Presentation**

Kissing Gate Barrier

Step Over Barrier



**Title of Slide Presentation**

K Barrier

Beneficial Designs Trail Gate Barrier Work


First Inverted Bollard Design

Motorcycle Testing

Second Inverted Bollard Design

Abilities EXPO

Third Inverted Bollard Design

Motorcycle Testing

**Title of Slide Presentation**

## Electronic Trail Gate Barrier

- Detect the presence of motorized trail vehicle at trail access entry
- Notify via phone or internet message
- Voice, image, text or GSM text message
- Report via alarm or dispatch service
- Capture of video before and after event
- Onsite alarm options


## Pedestrian and Motorized Vehicle Trail Traffic Counter

## Electronic TGB Specifications

- Infra-red sensor technology with fresnel lens
- Field of view is approx 2 degrees
- At 50 feet the field of view is approx 20 inches
- Dynamic detection of hot objects entering field of view

## Electronic Trail Gate Barrier

- Set up 32 inch clearance mechanical trail gate barrier with steel or concrete bollards
- Detect the presence of motorized trail vehicle at trail access entry point
- Silently report violation using desired format or onsite alarm

## Public Rights of Way Assessment Process (PROW-AP)

Peter Axelson, Barton Cline, Dana Helwig, Nathan Tolbert

Beneficial Designs, Inc.
Minden, Nevada

## Title of Slide Presentation

### Reasons for Assessment of Sidewalks

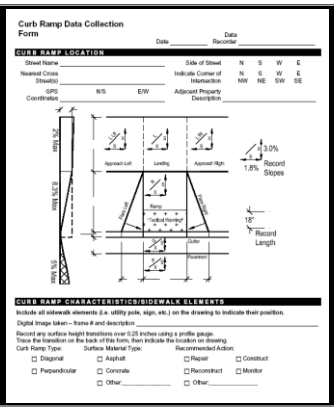
- Assess existing conditions
- Determine compliance with guidelines
- Identify obstructions and hazards
- Prioritize reconstruction

### Users of Detailed Sidewalk Data

- Sidewalk Planners
- Designers
- Engineers
- Contractors
- Inspectors

### SWAP

- Data collection along sidewalk segments
- Element Data
  - Curb Ramps
  - Driveway Crossings
  - Medians
  - Pork-chops etc.


Curb Ramp Data Collection Form

Date _____ Data Recorder _____

CURB RAMP LOCATION

Street Name _____ Side of Street N S W E

Nearest Cross Street(s) _____ Indicate Corner of Intersection NW NE SW SE

GPS Coordinates N/S _____ E/W _____ Adjacent Property Description _____

Approach Left Landing Approach Right

3.0% 1.8% Record Slopes

Ramp Flare Flare

Vertical Wall(s)*

18" Record Length

Gutter

Roadway

CURB RAMP CHARACTERISTICS/SIDEWALK ELEMENTS

Include all sidewalk elements (i.e. utility pole, sign, etc.) on the drawing to indicate their position.

Digital Image taken – frame # and description _____

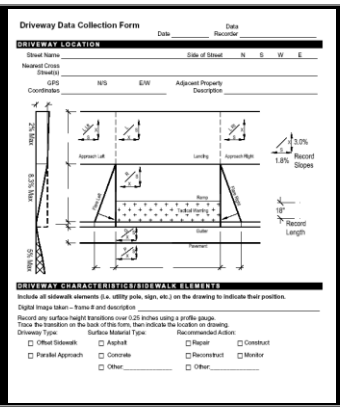
Record any surface height transitions over 0.25 inches using a profile gauge. Trace the transition on the back of this form, then indicate the location on drawing.

Curb Ramp Type: ☐ Diagonal ☐ Perpendicular

Surface Material Type: ☐ Asphalt ☐ Concrete ☐ Other:_____

Recommended Action: ☐ Repair ☐ Reconstruct ☐ Other:_____ ☐ Construct ☐ Monitor

# Title of Slide Presentation


Driveway Data Collection Form

Data _____ Data Recorder _____

DRIVEWAY LOCATION

Street Name _____ Side of Street: N S W E

Nearest Cross Street(s) _____

GPS Coordinates _____ N/S E/W Adjacent Property Description _____

5.0% 1.8% Record Slopes

18" Record Length

DRIVEWAY CHARACTERISTICS/SIDEWALK ELEMENTS

Include all sidewalk elements (i.e. utility pole, sign, etc.) on the drawing to indicate their position.

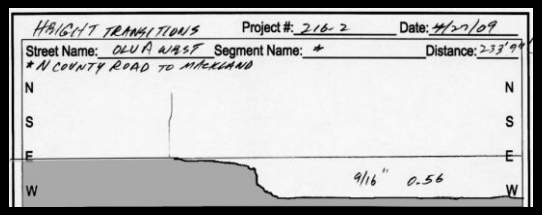
Digital Image taken – frame # and description _____

Record any surface height transitions over 0.25 inches using a profile gauge.
Trace the transition on the back of this form, then indicate the location on drawing.

| Driveway Type: | Surface Material Type: | Recommended Action: |
|---|---|---|
| ☐ Offset Sidewalk | ☐ Asphalt | ☐ Repair ☐ Construct |
| ☐ Parallel Approach | ☐ Concrete | ☐ Reconstruct ☐ Monitor |
| | ☐ Other:_____ | ☐ Other:_____ |

## SWAP

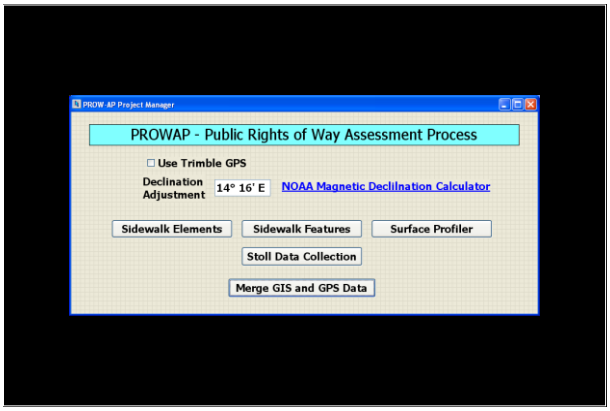
- Tedious
- Time Consuming
- Bending and squatting – 10-20x per sidewalk element and on sidewalk segments

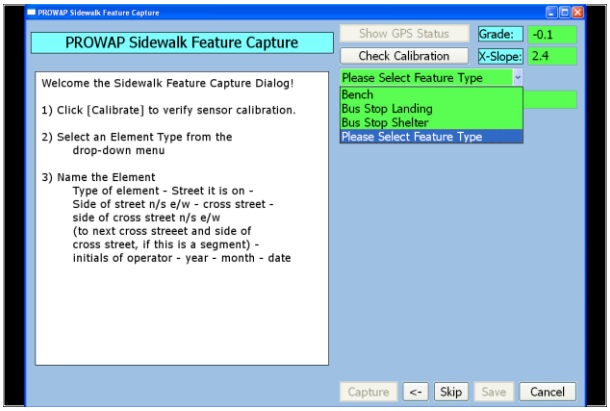


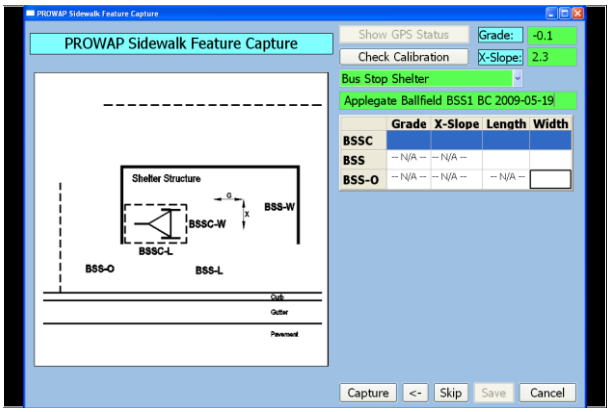

## Manual Data Collection Error Potential

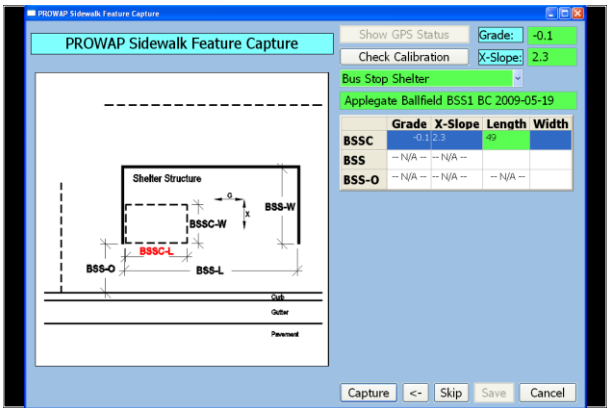
- Smart level in wrong units
- Smart level on hold
- Misreading of smart level
- Data recording errors
- Data entry error

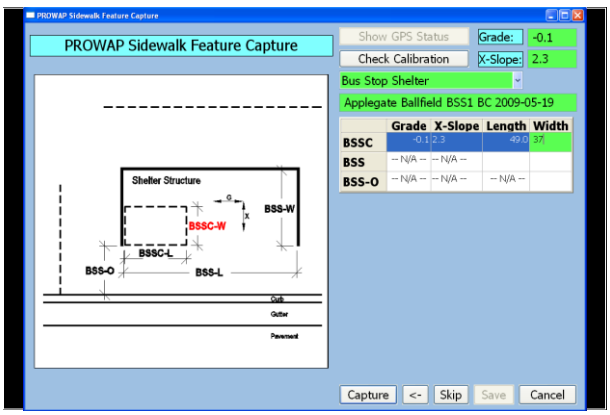
# Title of Slide Presentation

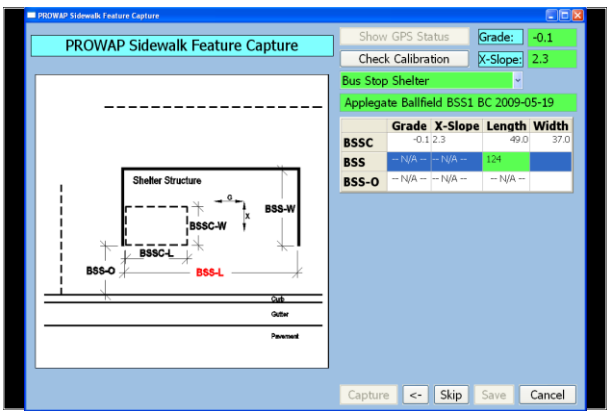


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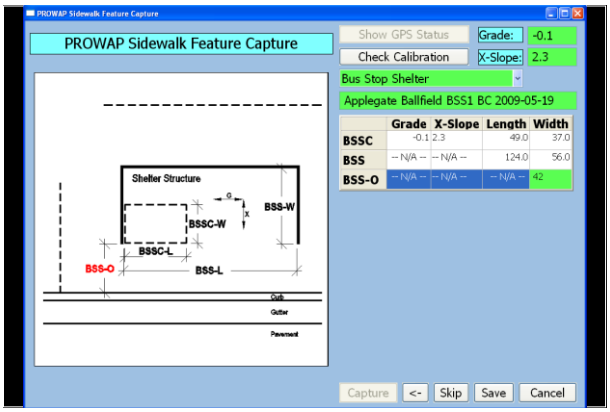


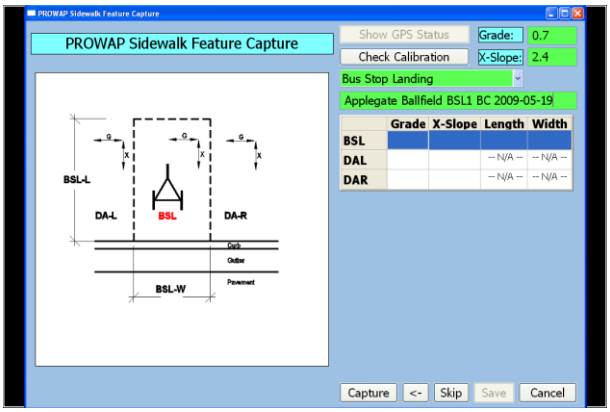


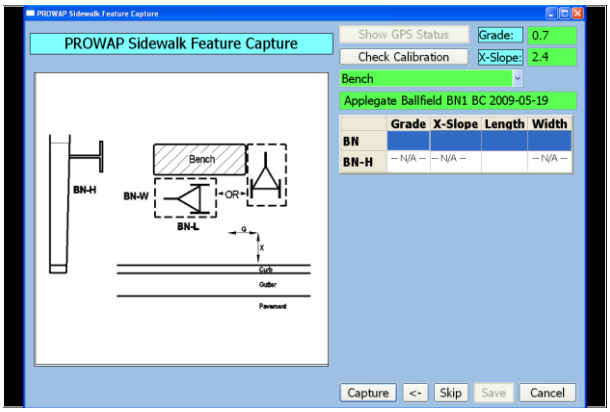


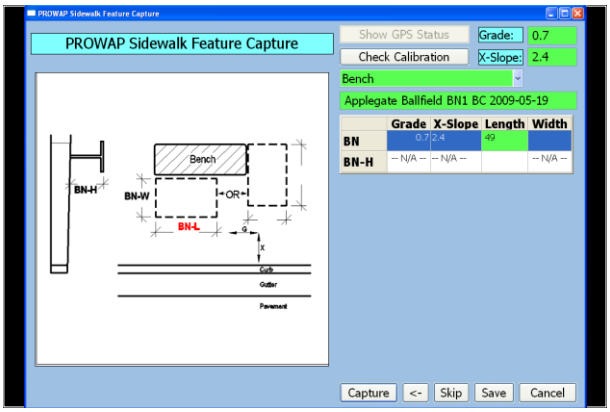


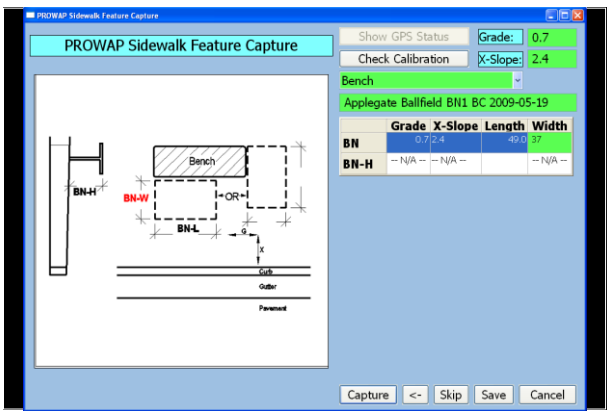


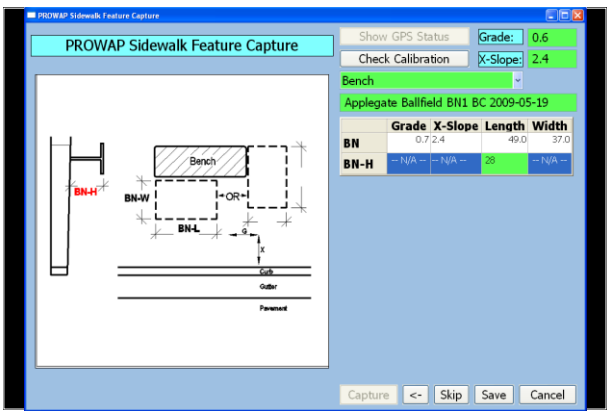

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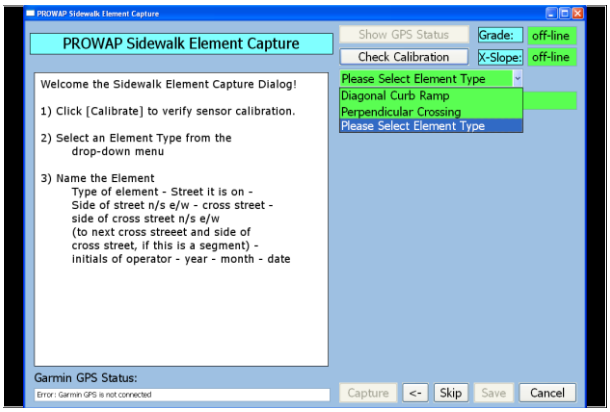
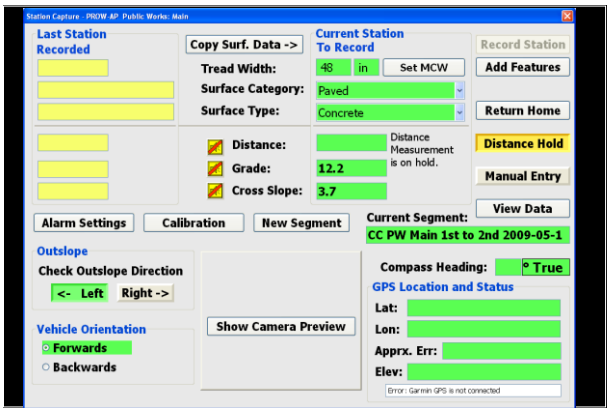
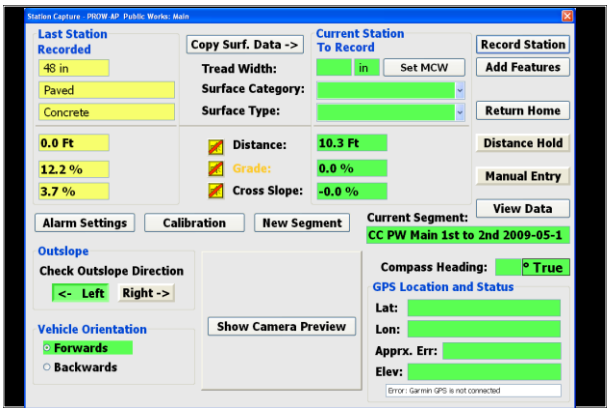



## Data Export

- SQL data structure
- Trimble Pathfinder Office
- Into GIS Software
- Into CAD Software
- Excel

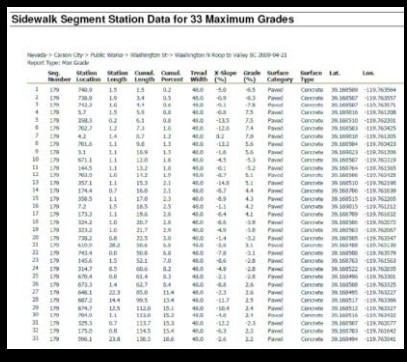



**Sidewalk Access Summary Info**
**Carson City**
**Washington St**
**Wash. N Roop to Valley JV 2009-04-21**

Assessment Date:
Agency: Public Works
State: Nevada
County:

| | | | |
|---|---|---|---|
| Trail Length: | 0.1 mi (0.2 km) | Trail Type: | |
| Elevation: Gain: | 6.3 ft (1.9 m) | | |
| Loss: | 2.7 ft (0.8 m) | | |
| Typical Grade: | 1.2% | Maximum Grade: | 8.5% |
| Typical Cross Slope: | 4.2% | Maximum Cross Slope: | 17.0% |
| Typical Tread Width: | 48.0 in (121 cm) | Minimum Tread Width: | 30.0 in (76 cm) |



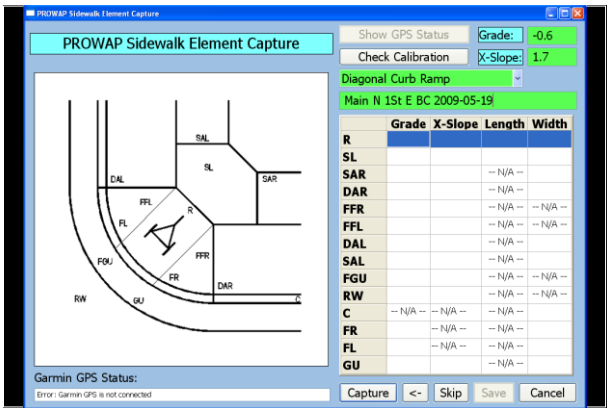
# Title of Slide Presentation

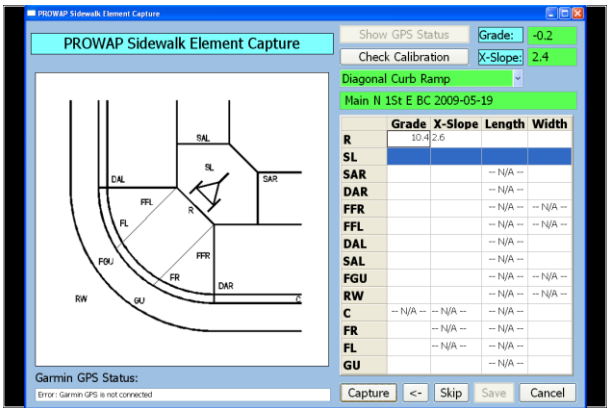
## Repeatability Segment Testing

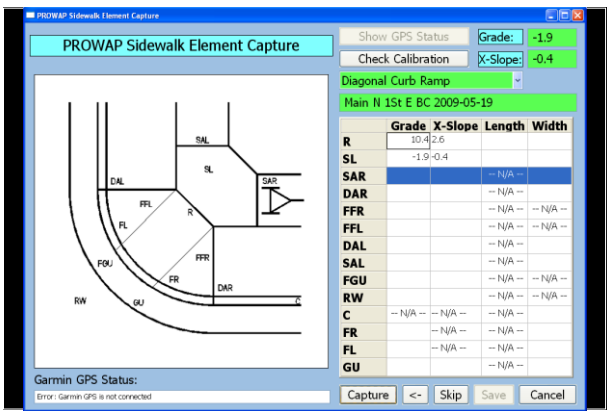
- Typical grades and cross slopes were within 0.5%
- Maximum grades and cross slopes were within 2.0%

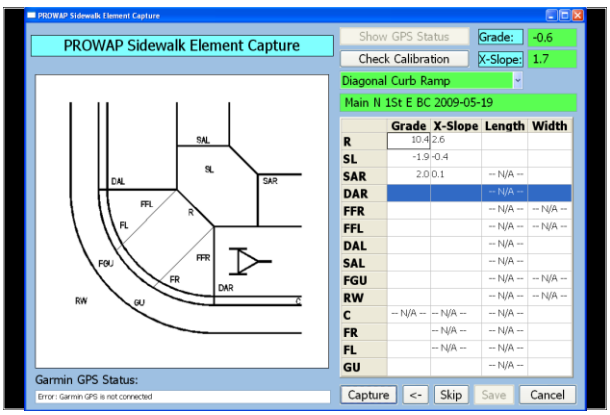
## Time Study of Sidewalk Element Measurement

- 5 Curb Ramps and 5 Driveway crossings measured with SWAP and PROW-AP
- Measured by 5 different assessment coordinators without experience
- 75 - 80% time savings noted



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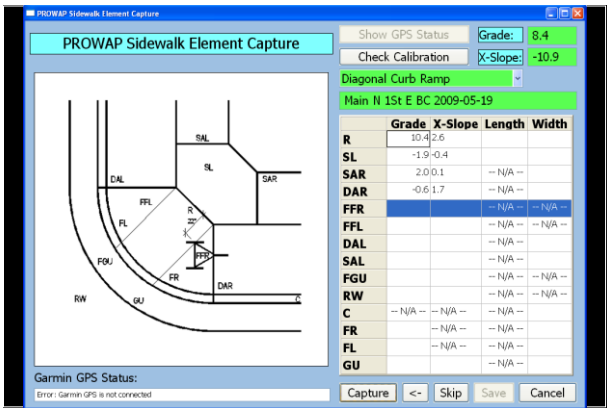


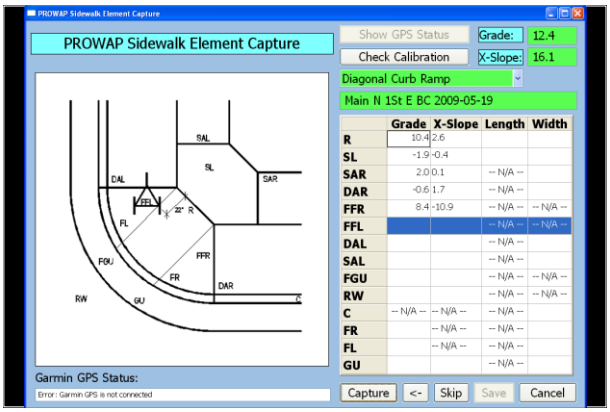


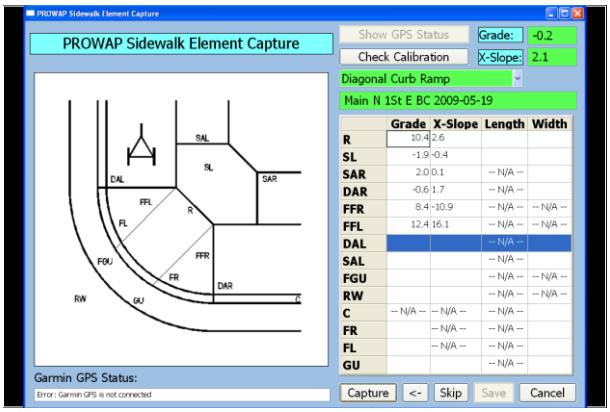


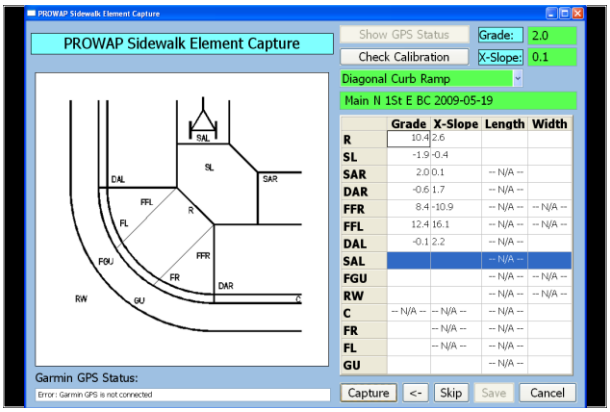


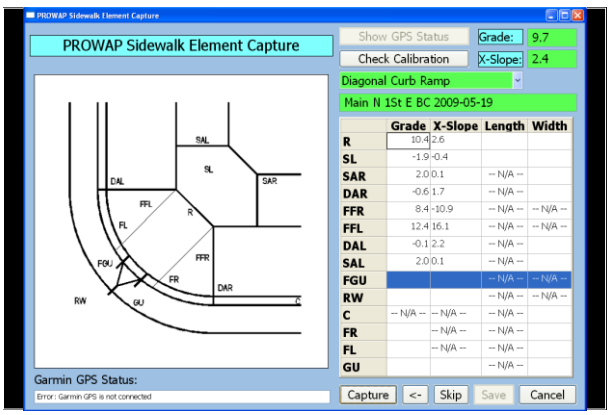


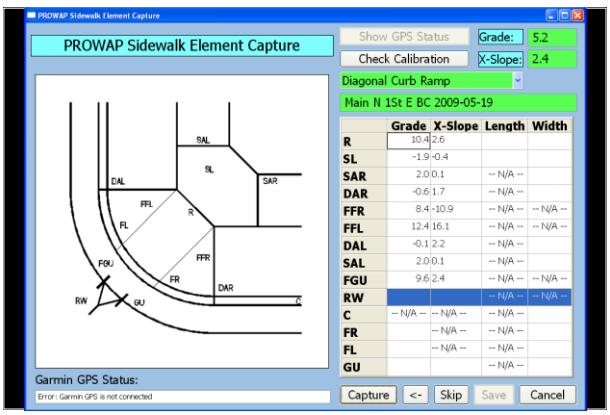

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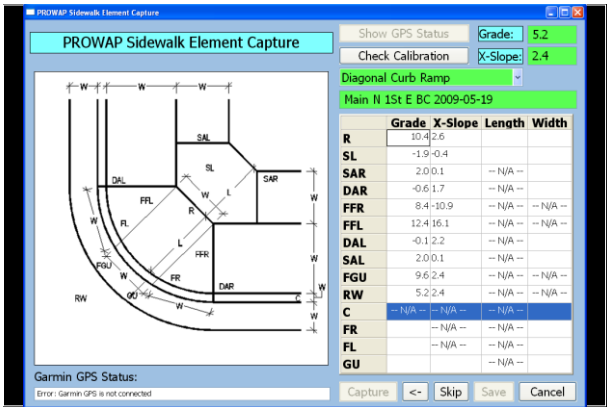
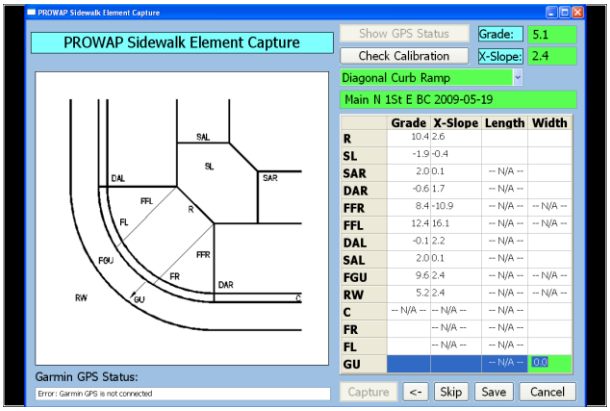
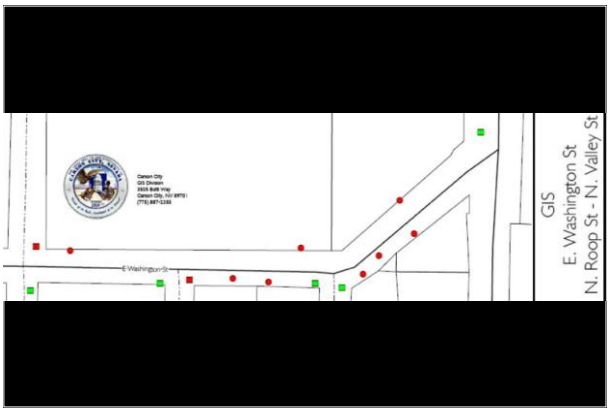
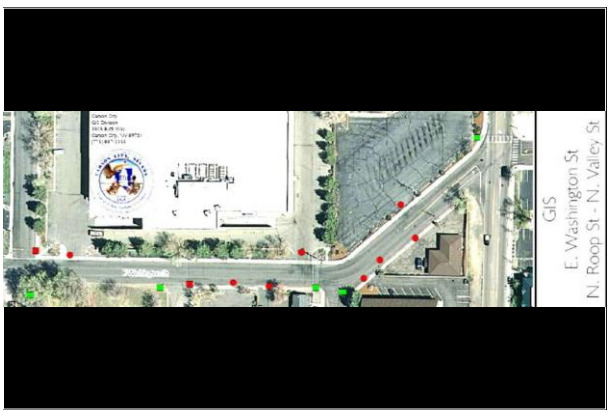


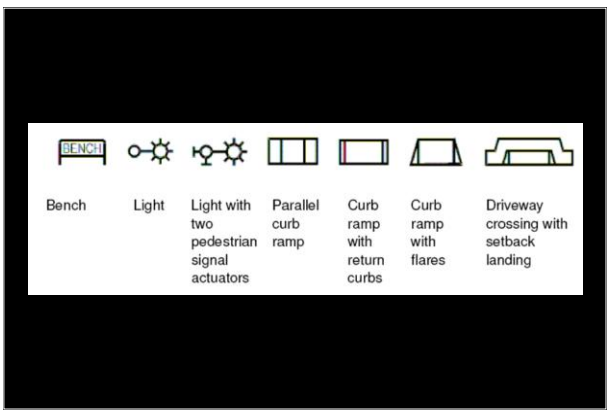




## Designing for GIS Compatibility

- Points – Features – Elements
- Lines – Sidewalk corridors
- Sidewalk symbol font library



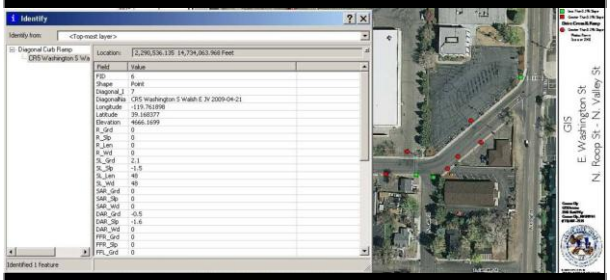



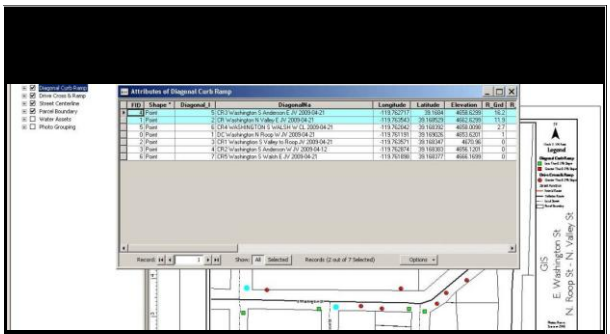
**Title of Slide Presentation**

## Creation of Shape Files

Use CAD software to process data
- AutoCAD Map
- Microstation

Or bring data into GIS software using scripts written for the data
- ArcMap with ArcInfo




## PROW-AP Municipality Benefits

Prevention of liability
Reduction in complaints
Reduce need to reconstruct

## PROW-AP Benefits

75-80% less personal time required
Automatic data recording
Less physical stress and fatigue
No hard paper copies
Increased data accuracy

## Acknowledgement

Phase I SBIR funding for the High Efficiency Pedestrian Sidewalk Assessment Process was provided by the U.S. Department of Transportation through Federal Highways Administration grant number DTRT57-08-C-10058.

## Title of Slide Presentation

### Improving Trail Surfaces

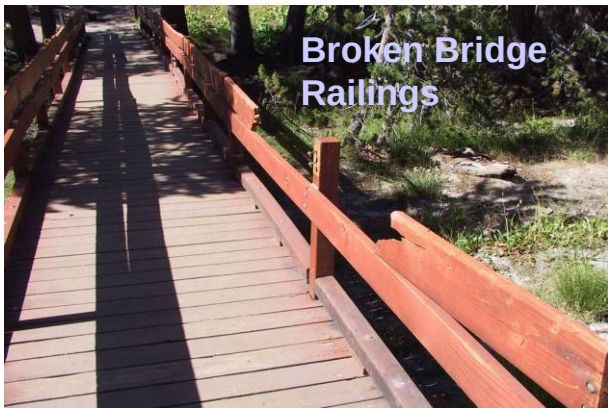
- Provide firm and stable surfaces
- Remove trail obstructions
- Protect environmental and cultural resources




### Tahoe Meadows Interpretive Trail Accessibility Improvements

## Title of Slide Presentation

New Culverts





**Soil Stabilization Products**

- Safety Tred II
- EGA 20
- Envirogrid Paver
- GeoBlock2
- Gravelpave2

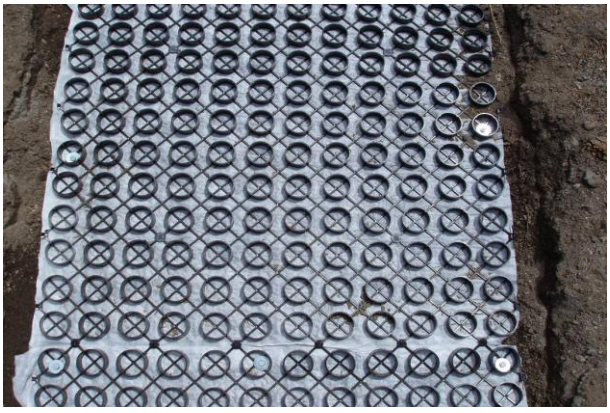

## Title of Slide Presentation





## Title of Slide Presentation


Gravelpave2
Before
Installation



Gravelpave2
After
Installation

Rotational
Penetrometer

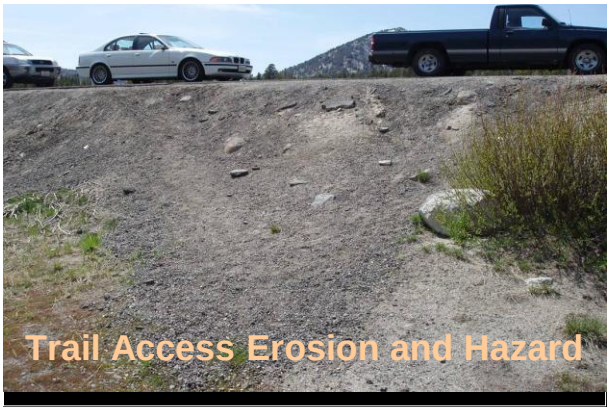
## Title of Slide Presentation

### Rotational Penetrometer Readings-Gravelpave 2

| ***Before*** Application | | | ***After*** Application | | |
|---|---|---|---|---|---|
| Firmness | | Stability | Firmness | | Stability |
| 0.18 | | 0.77 | 0.17 | | 0.37 |
| 0.17 | | 0.87 | 0.17 | | 0.38 |
| 0.17 | | 0.77 | 0.18 | | 0.42 |
| 0.18 | | 0.88 | 0.17 | | 0.35 |
| 0.18 | | 0.79 | 0.18 | | 0.40 |
| 0.18 | Avg | 0.82 | 0.17 | Avg | 0.38 |




**Title of Slide Presentation**



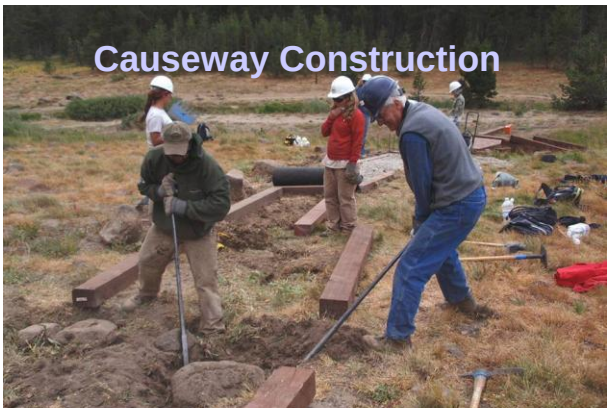

Stair Construction

New East Stair

New West Stair

Existing Causeway

**Title of Slide Presentation**





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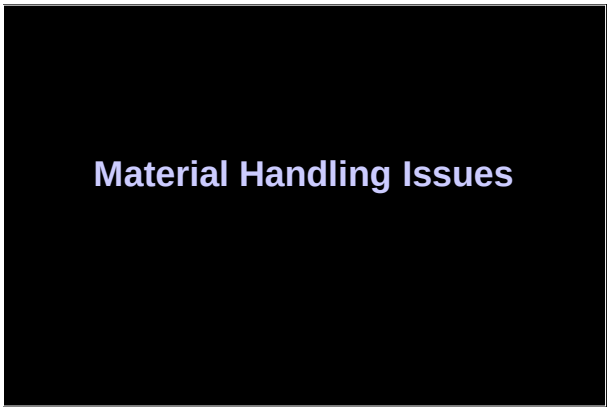


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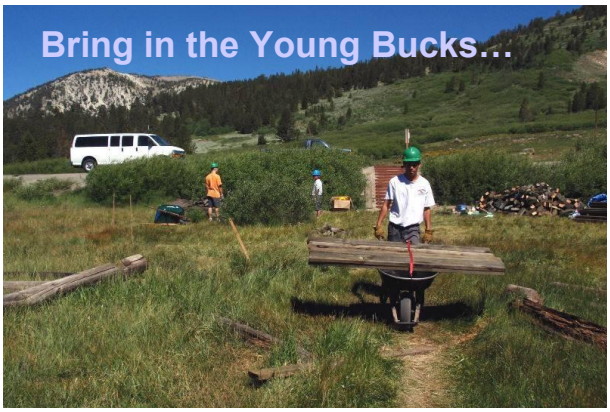




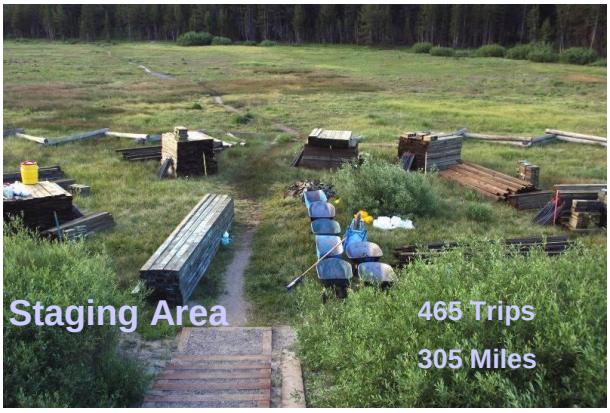


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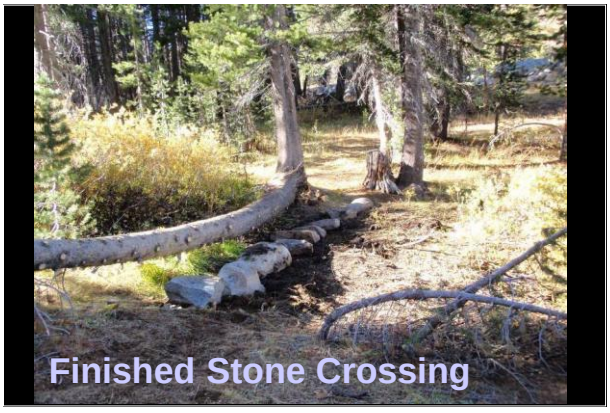
**Title of Slide Presentation**





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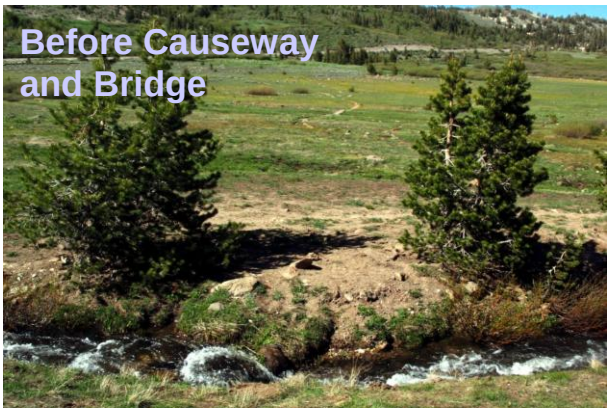
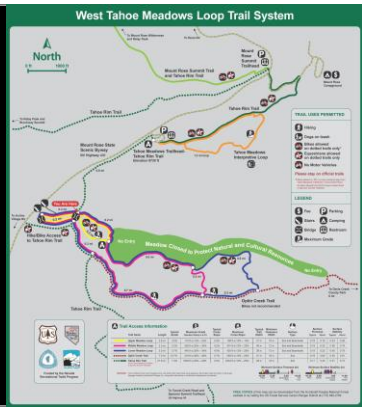





# Title of Slide Presentation


Interpretation

Area Map




Happy People…and Happy Dogs

## Funding Support

Nevada Recreational Trails Program-
Nevada Division of State Parks

Administered by the Federal Highway Administration (FHWA)

Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU)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